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A METHOD OF INDUCING PSYCHOINTELLECTUAL ACTIVITY AND THE PROBLEM OF LONG-TERM PREDICTION OF SCIENTIFIC INVESTIGATIONS

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Block	Italic	Transliteration	Block	Italic	Transliteration
А а	*А а*	A, a	Р р	*Р р*	R, r
Б б	*Б б*	B, b	С с	*С с*	S, s
В в	*В в*	V, v	Т т	*Т т*	T, t
Г г	*Г г*	G, g	У у	*У у*	U, u
Д д	*Д д*	D, d	Ф ф	*Ф ф*	F, f
Е е	*Е е*	Ye, ye; E, e*	Х х	*Х х*	Kh, kh
Ж ж	*Ж ж*	Zh, zh	Ц ц	*Ц ц*	Ts, ts
З з	*З з*	Z, z	Ч ч	*Ч ч*	Ch, ch
И и	*И и*	I, i	Ш ш	*Ш ш*	Sh, sh
Й й	*Й й*	Y, y	Щ щ	*Щ щ*	Shch, shch
К к	*К к*	K, k	Ъ ъ	*Ъ ъ*	"
Л л	*Л л*	L, l	Ы ы	*Ы ы*	Y, y
М м	*М м*	M, m	Ь ь	*Ь ь*	'
Н н	*Н н*	N, n	Э э	*Э э*	E, e
О о	*О о*	O, o	Ю ю	*Ю ю*	Yu, yu
П п	*П п*	P, p	Я я	*Я я*	Ya, ya

*ye initially, after vowels, and after ъ, ь; e elsewhere. When written as ë in Russian, transliterate as yë or ë. The use of diacritical marks is preferred, but such marks may be omitted when expediency dictates.

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RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

Russian	English
sin	sin
cos	cos
tg	tan
ctg	cot
sec	sec
cosec	csc
sh	sinh
ch	cosh
th	tanh
cth	coth
sch	sech
csch	csch
arc sin	$\sin^{-1}$
arc cos	$\cos^{-1}$
arc tg	$\tan^{-1}$
arc ctg	$\cot^{-1}$
arc sec	$\sec^{-1}$
arc cosec	$\csc^{-1}$
arc sh	$\sinh^{-1}$
arc ch	$\cosh^{-1}$
arc th	$\tanh^{-1}$
arc cth	$\coth^{-1}$
arc sch	sech^{-1}
arc csch	csch^{-1}

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rot	curl
lg	log

A METHOD OF INDUCING PSYCHOINTELLECTUAL ACTIVITY AND THE PROBLEM OF LONG-TERM PREDICTION OF SCIENTIFIC INVESTIGATIONS

V. Chavchanidze (USSR)

Inducing psychointellectual activity means a particular method of controlling the intellectual activity of a group of people during the solution of a problem (under specially created conditions) with the following characteristics.

1. Controlling intellectual activity assumes special selection of participants in the process of psychointellectual generation (PIG); these participants would satisfy the requirements of psychological compatibility and high qualifications. Psychological compatibility is the minimum requirement; psychological adaptation would be more effective.

2. The leader creates a special rhythm of psychointellectual generation. Question and answer sessions should be replaced by periods of unexpected changes, comparisons, and examples.

3. The process of PIG is carried out on the basis of an earlier developed psychoheuristic program. The experiment concludes when the problem or tasks have been solved or basically solved. The PIG process permits deviations from the heuristic program with subsequent fixation of the necessary additional information, examples and recommendations in a form that is suitable for generalization.

4. PIG should take place under conditions maximally permitting the development of a creative, elevated mood with maximum communication capabilities of the participants, for which the appropriate information and organizational — technical support of the experiment is vital.

There is a specially developed system (unique for each form of intellectual activity) for insuring PIG. It includes systems of imagery, communication of participants, style, room interiors, etc. The system of insuring PIG provides for eliminating fatigue, stress, and over-excitement, which requires special scientifically developed procedures for restoring intellectual working capacity in a brief period of time.

5. A specific form of PIG requires preliminary experimental development of the psychoheuristic program for the given form of intellectual activity ("prediction", "analysis", "planning", "examination", "decision making", etc.) as well as a corresponding system of support. Similar to the way in which mathematical programs differ from each other and are adapted to various computers, there is no single psychoheuristic program or system of PIG support.

Each psychoheuristic program has its own "key" which insures its effectiveness, just as each form of intellectual activity requires special forms. During psychoheuristic programming, the object which "requires" the program is man, while the machine plays a supporting role.

Compiling the "self teaching" psychoheuristic program is linked with multiple testing of the program for suitability with the use of different effectiveness criteria.

The method of compiling new psychoheuristic programs has still not been finally formulated, but general recommendations on organizing the experiment and fixing its results have been developed. In the process of compiling the method, the task was posed of creating a system of informal, computer-free "decision generator" of problems of planning and predicting scientific investigations. The solution was found during cybernetic formulation of the problem of approaching the goal. In our view, planning and prediction in science should be "by objects": the same object should be studied from the vintage point of many sciences, which corresponds to decreasing the number of goal problems. It is expedient to divide it into subproblems, and these

subproblems should be classified with an accuracy up to the distinguishing theoretical or experimental indices.

As a result of direct experiments on subjects, it was found that the most effective methods of scientific search are those based on goal setting which satisfies the cybernetic requirements.

We shall examine a general system of planning the solution to a problem. The problem is solved by "guiding" the subject to the goal which satisfies the criteria of control, reproducibility and universality (the so-called cybernetic criteria).

It should be noted, however, that the success of the experiment presently depends on the breadth of viewpoint and erudition of the leader, although the work of the leader is formalized within limits of the possible and is facilitated by using special devices and by involving a group of experts in planning; the leader can consult the experts if necessary. The leader also has at his disposal "question generators" which store a system of critical questions developed on the basis of a series of tests on scientists. The nature of the questions which the leader asks the subject depends on the subject's answers. With respect to decisions, ideally they should be worked out by a special device. Practically, however, the leader makes decisions, particularly in complex cases.

The "memory" is designed to preserve the answers of the subjects; at the request of the leader, the answers can be entered in the memory from a mimic panel (imagery system) or taken from the memory to the mimic panel, which permits the subject and the leader to be better oriented in the experiment.

The "comparer" plays a special role. It should be possible for the leader rapidly to evaluate the suitability of each answer given by the subject. For this purpose, by the aid of comparison, it is vital to clarify on exactly which points the answer is not suitable for further reaching the goal and correspondingly to correct further questions.

The formulated approach is equivalent to the approach of Nuell, Simon and Shaw in constructing heuristic programs. The only difference consists in the fact that the data which the leader deals with in developing the optimal plan of scientific work have an informal appearance.

The semantic objects which the leader deals with and whose content is subject to transformation can be divided into three groups:

- formulations and determinations (the problem, the main subproblem, the subproblem, the goal of solving the problem, the goal of solving the subproblem, the goal of solving the main subproblem);

- ideas (complete solution, the working idea), enumeration of working ideas;

- enumeration of difficulties

The requirements which the leader must impose on the semantic objects are specific for each of the groups.

We developed an experiment system which produces a graphic representation of the actions of the subject, the leader, and the computer in developing an optimum plan for solving a scientific problem. The experiment begins with the question "problem", asked the leader by the "question generator". When the leader poses the question: "Which problem formulation?" the subject answers: "Formulates the problem". This answer enters the "memory", after which the entire cycle of transferring actions from the computer through the leader to the subject is repeated. The leader's check of different conditions noted in the system is carried out by the aid of the "comparer", who suggests the appropriate criteria and recommendations.

The unique feature of the system is the presence of cycles which make it possible once again to cover certain sections of the procedural circuit. For example, lack of correspondence of the goal

of solving the problem and formulation of the problem stimulates verification of the latter.

In the final analysis, formulations of the problem, goals of problem solving, of the main subproblem, and goals of solving the main subproblem as well as a method and plan of solving the main subproblem are developed.

In practical use of the method, well known scientists — supervisors of scientific collectives — were invited to be subjects. Leading Fellows of the Institute of Cybernetics played the role of experts. In the course of the experiment, the scientist was invited either independently (without lead questions) to explain which problem he was working on, how he set goals for himself, and how he planned the solution for the problem, or to fill out a special questionnaire. After a preliminary study of the condition of the subject, the experiment itself was carried out with the participation of the leader.

An analysis of the results of the experiments showed that in most cases the subjects answer the question: "What is the goal of solving your problem?" — not by stating a scientific goal, but by a statement of the motives linked with posing the scientific goal. Therefore, it is extremely important to achieve a clear formulation of the goal from the subject himself. If the subject is not in a condition to formulate the goal in the required fashion, in the course of the "verification" cycle (verifying the goal), by the aid of a number of specific questions the subject is led to recognition of the nature of the goal.

Setting up the process of solving the main subproblem differs from the previous cycle only by its content. During this process, in order to fully present the problem to the subject, it is suggested to enumerate other subproblems which make possible an approach to problem solving from a new side. The next questioning of the subject basically pertains to solving the main subproblem and the difficulties encountered during this process. Here, an analysis is

made of the entire list of difficulties, and possible ways of achieving the goal set for the investigator are traced. Questions for the subject are formulated in a way which stimulates him to clarify significant items which he earlier did not even suspect existed.

All this makes it possible to determine the character of solving the main subproblem. Particular attention is paid to originality or unusual approach which distinguishes it from the generally accepted point of view. The subject's attention is in fact concentrated on this aspect. A large role in revealing the direction of further work is played by clarifying the plan of action in case the anticipated results of solving the main subproblem do not correspond with the results obtained. With this goal, the subject is questioned on a change in formulation of the main subproblem, which enables him to consider many factors which he had earlier not given his attention.

Finally, the subject is asked to present the problem, the goal of solving the problem, and the idea or plan of solving the main subproblem in final form. It should be pointed out that in the experiment a great deal of attention was paid to investigating the psychological preparedness of the subject to accept any of the concepts. His attitude regarding the possibility of scientific planning, and cooperation with other scientists and scientific collectives, etc., was clarified.

As the experiment shows, in the course of PIG the subjects rapidly become accustomed to the new situation and, as a rule, agree with the cybernetic presentation of the goal of solving the problem, which in their opinion, greatly accelerates the solution.

At the end of the experiments, the subjects were asked to give their impressions of the meeting and to point out whether or not it helped them to clarify certain questions or to isolate questions which had earlier not come up for them. All of the subjects noted

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the undoubted usefulness of the experiment and the great satisfaction it had given them. They indicated the necessity of constantly using the examined method in planning scientific work.